Uncommon forms of AV reentry: atrio and fasciculo-ventricular fibers, slow conducting fibers

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Common forms of AV reentry

- Accessory pathways:
  - Upper insertion: atrium
  - Lower insertion: ventricle
  - Conduction time: short and fixed
- AV nodal reentry:
  - Up the fast, down the slow pathway

Uncommon forms of AV reentry

- Accessory pathways:
  - Upper insertion: AV node
  - Lower insertion: right bundle (fascicle)
  - Conduction time: long and/or decremental
- AV nodal reentry:
  - Up the slow, down the fast pathway

Uncommon forms of AV reentry in real life

- Accessory pathways:
  - Antegradely conducting ("antegrade only"):
    - Atrio-fascicular
    - Atrio-ventricular with long conduction time
    - Nodo-fascicular
    - Nodo-ventricular
    - Fasciculo-ventricular: no reentry
  - Retrogradely conducting (concealed):
    - Atrio-ventricular with long conduction time
- AV nodal reentry:
  - Up the slow, down the fast pathway

Uncommon forms of AV reentry in real life

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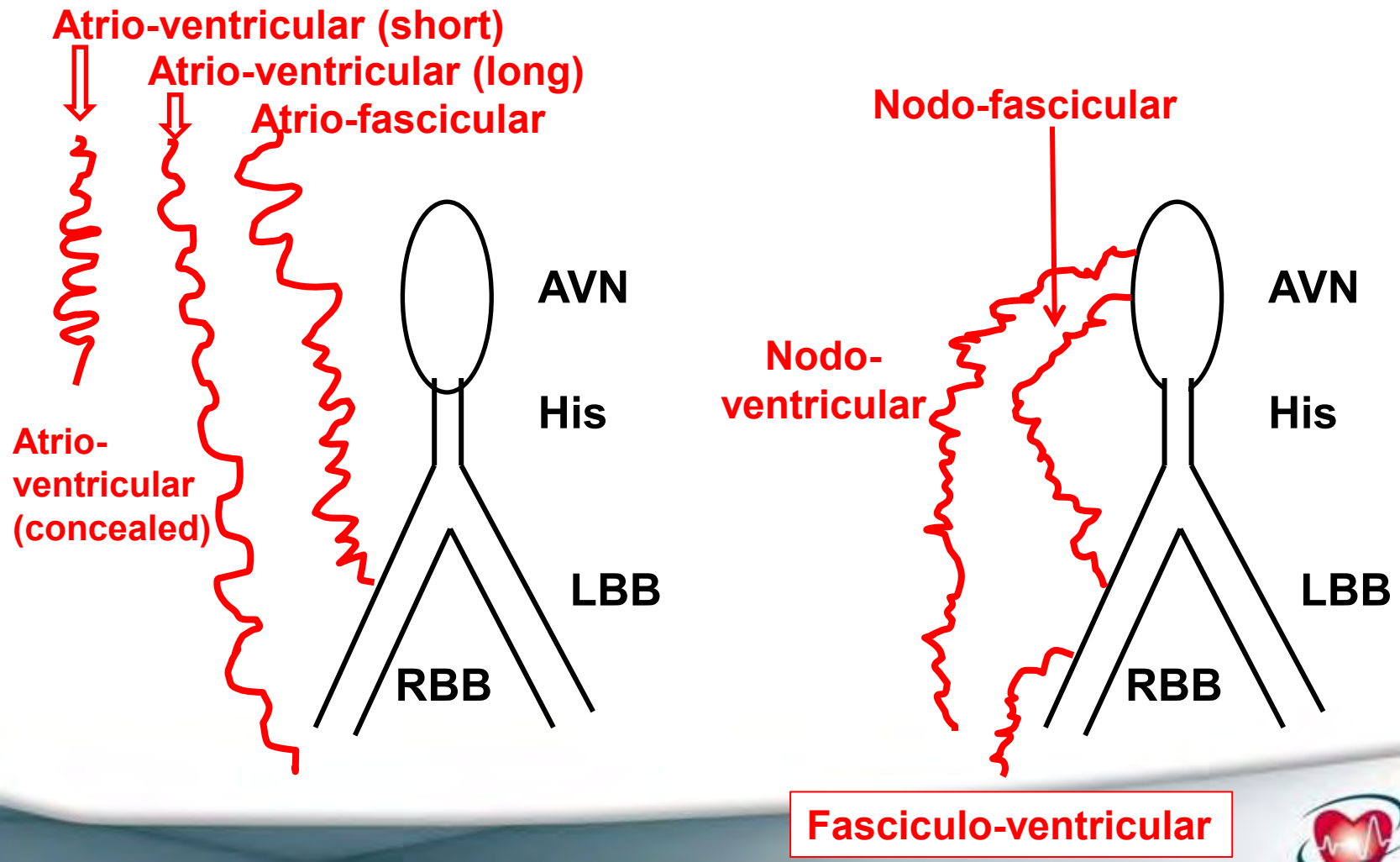
Mahaim

Coumel

Schematic representation of uncommon AP



Uncommon forms of AV reentry in real life

- Accessory pathways: **How common they are:**
  - Antegradely conducting ("antegrade only"):
    - Atrio-fascicular +++
    - Atrio-ventricular with long conduction time +++
    - Nodo-fascicular +
    - Nodo-ventricular +
    - Fasciculo-ventricular: no reentry ++
  - Retrogradely conducting (concealed):
    - Atrio-ventricular with long conduction time ++++
- AV nodal reentry:
  - Up the slow, down the fast pathway ++++

Atrio-fascicular and atrio-ventricular AP with long conduction time: common features

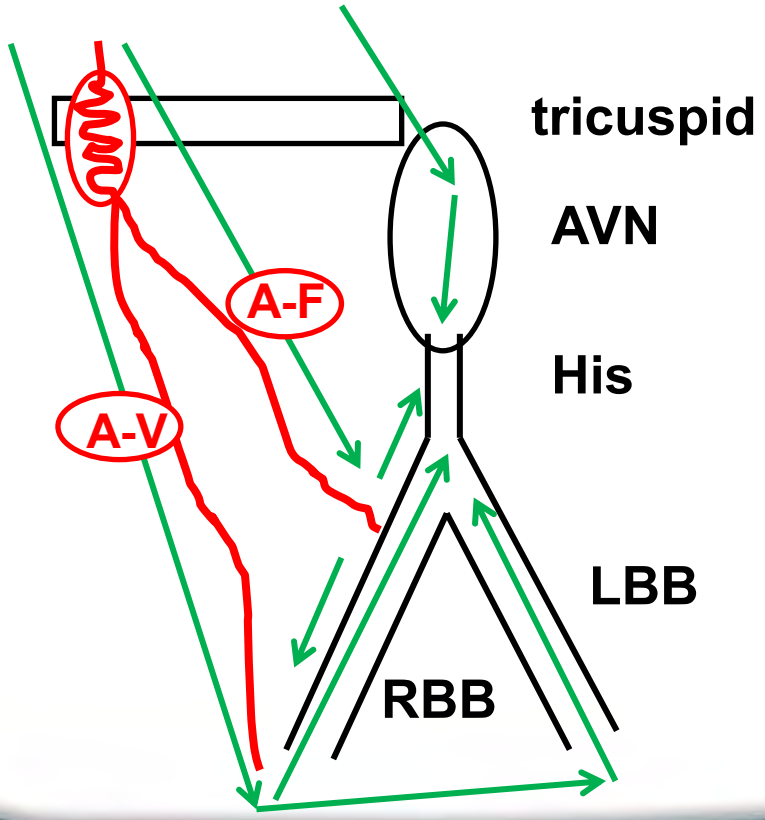
- Right sided: atrial insertion in lateral tricuspid annulus
- Distal insertion: RB (fascicular) or RV (ventricular)
- Antegrade decremental conduction
- No retrograde conduction
- Frequent association with dual AVN pathways

Consequences:

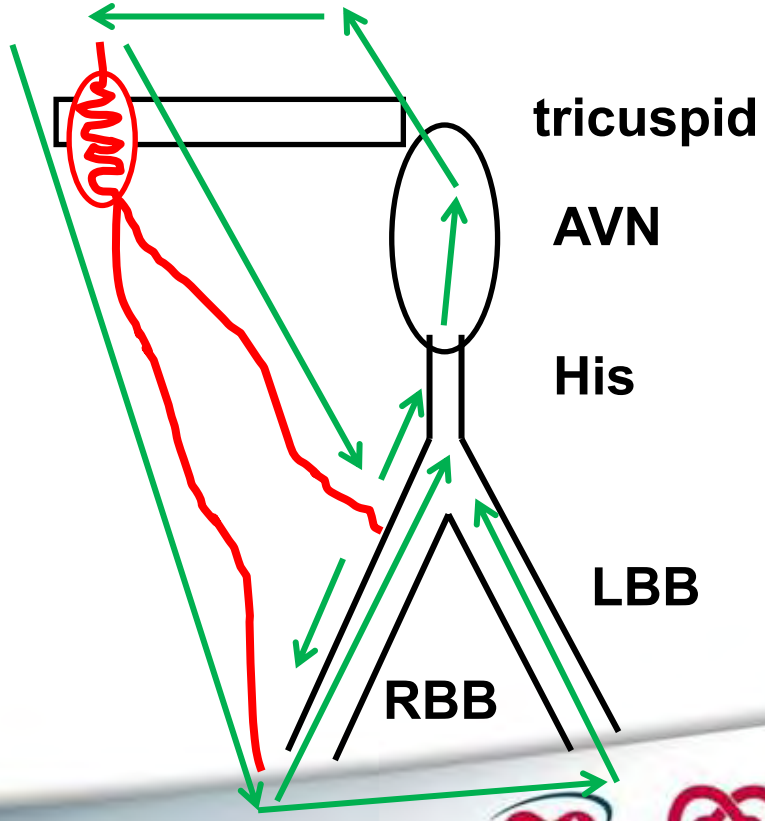
- No or modest degree of preexcitation in SR
- Preexcitation appears w atrial pacing / extrastimuli
- Degree of preexcitation depends on site of A pacing
- HV interval w preexcitation depends on site of distal insertion: if RB: HV≈0; if RV: HV≈-50; if RBBB: HV≈-100
- Antidromic tachycardias: LBBB QRS: DD w AVN reentry

Conduction through A-fascicular A-ventricular AP with long conduction time

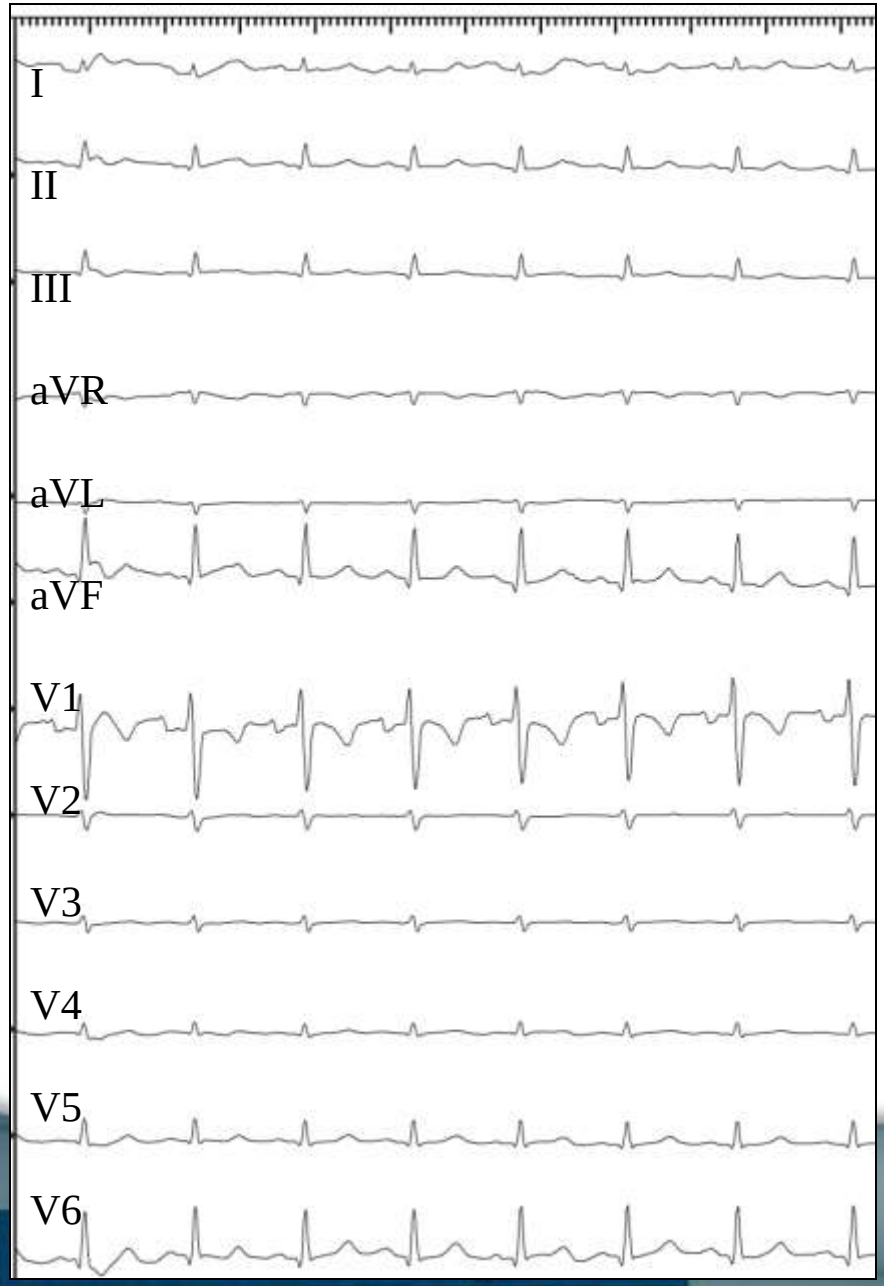
SR – A pacing



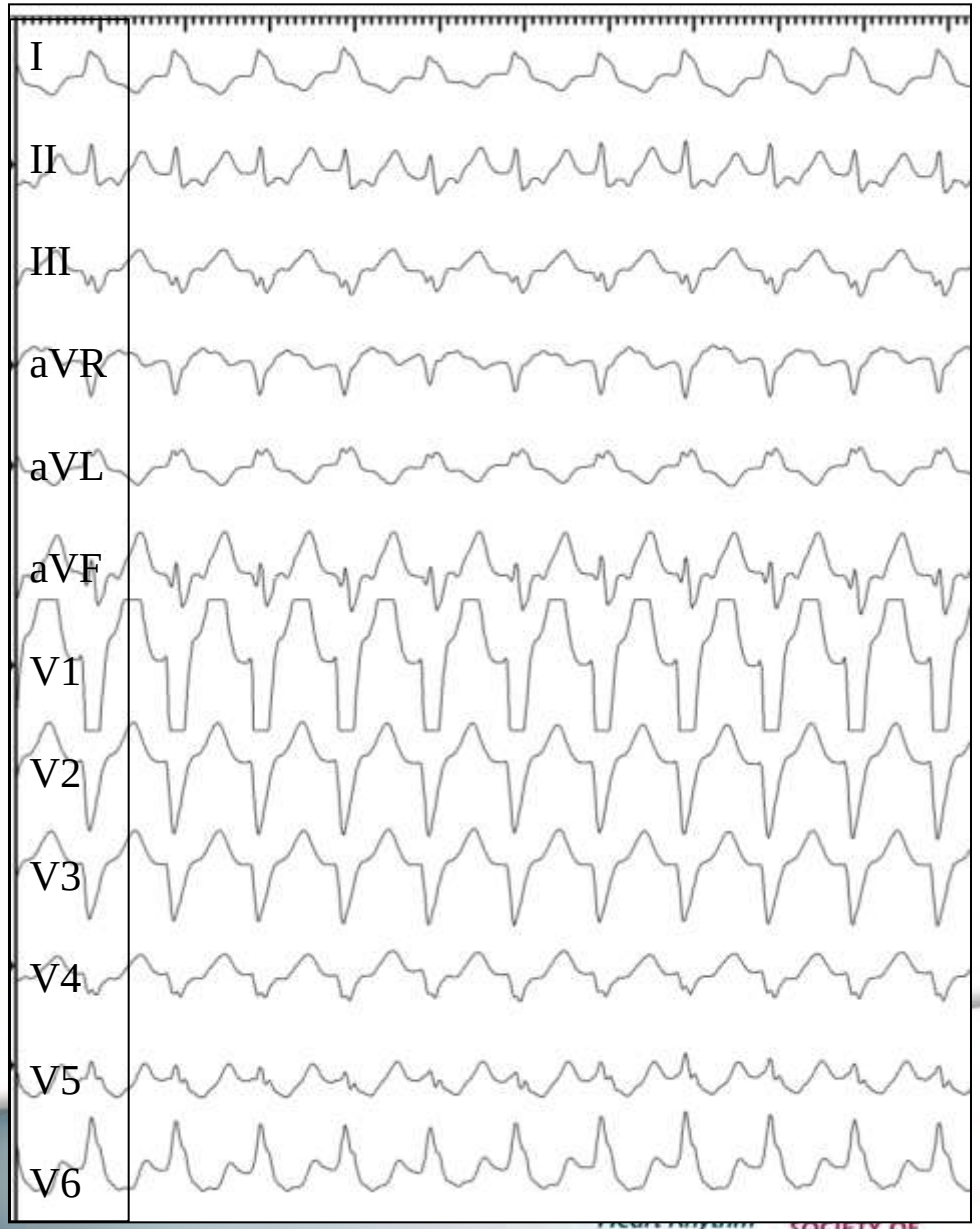
Antidromic tach



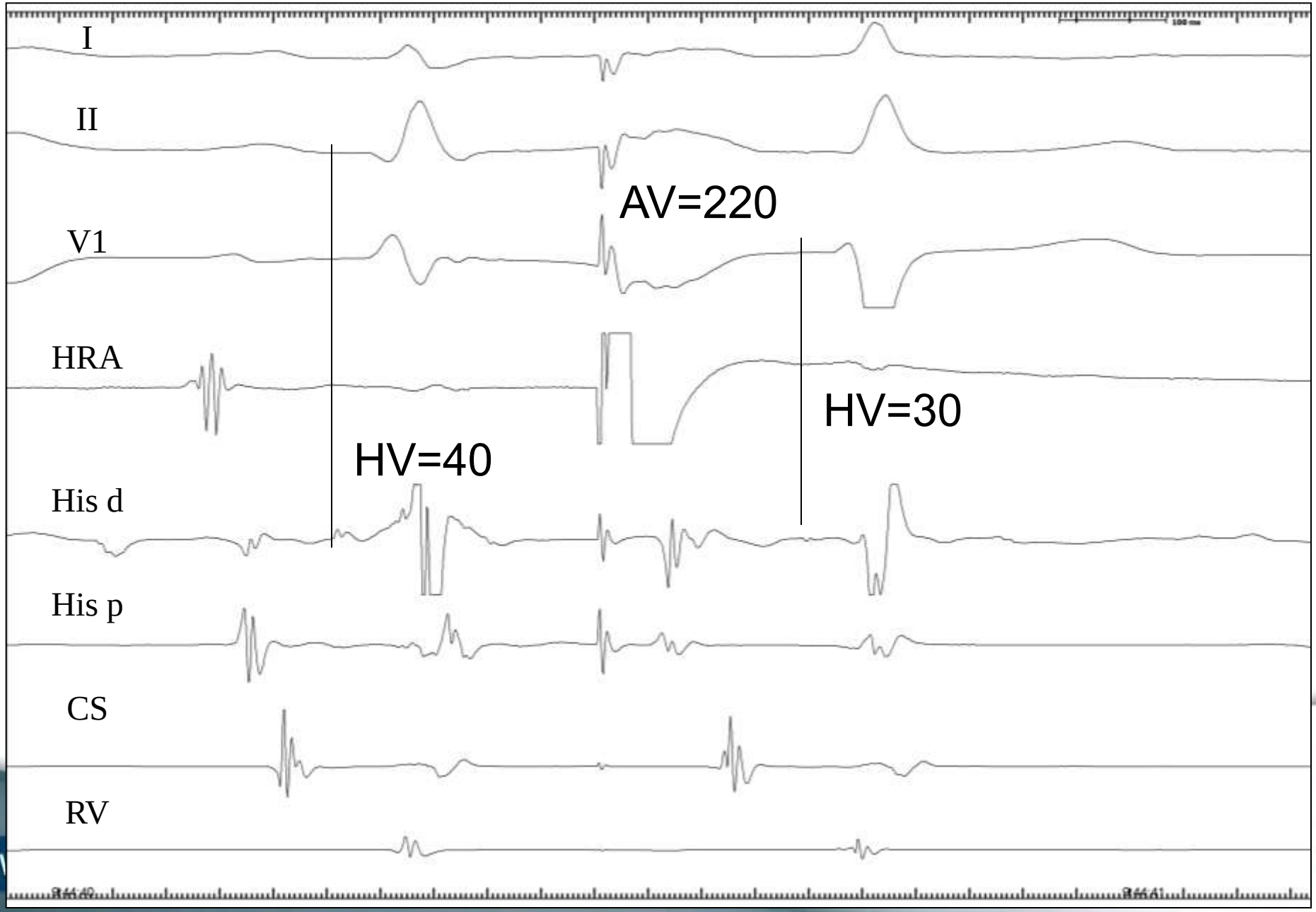
baseline ECG



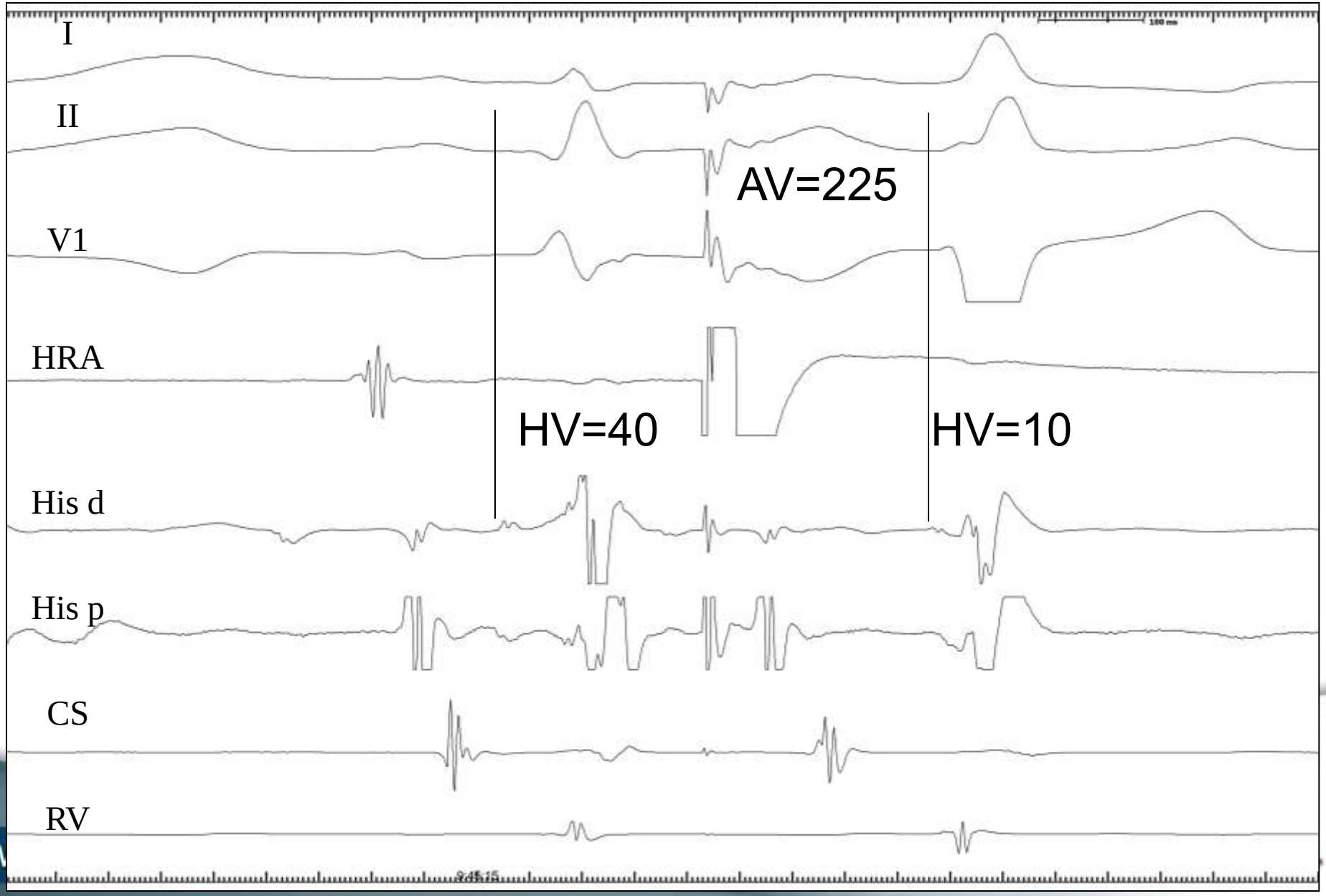
Tachycardia: CL 400 ms, QRS 130 ms



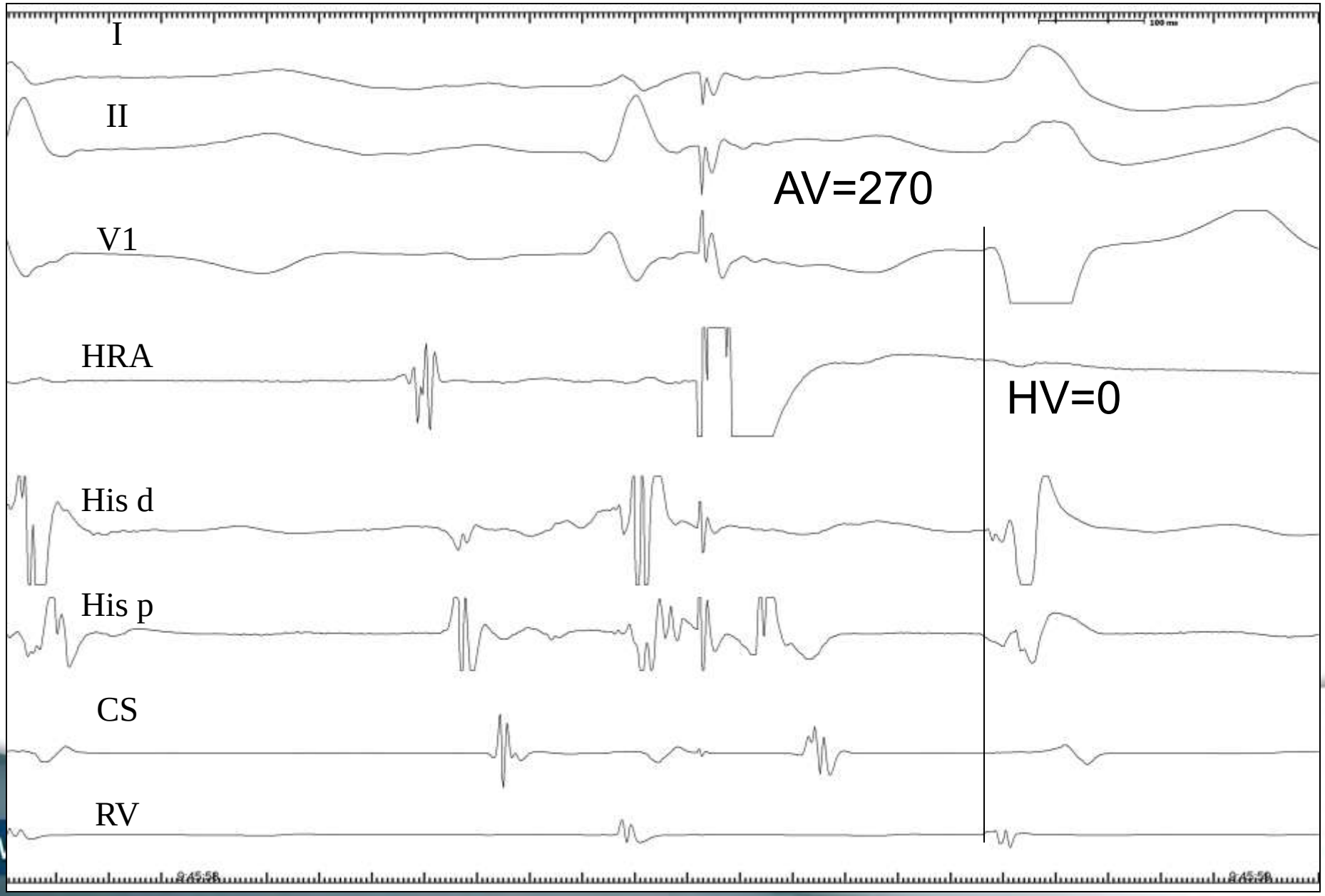
Defining physiology: Atrial extrastimulus during SR, CI 370 ms



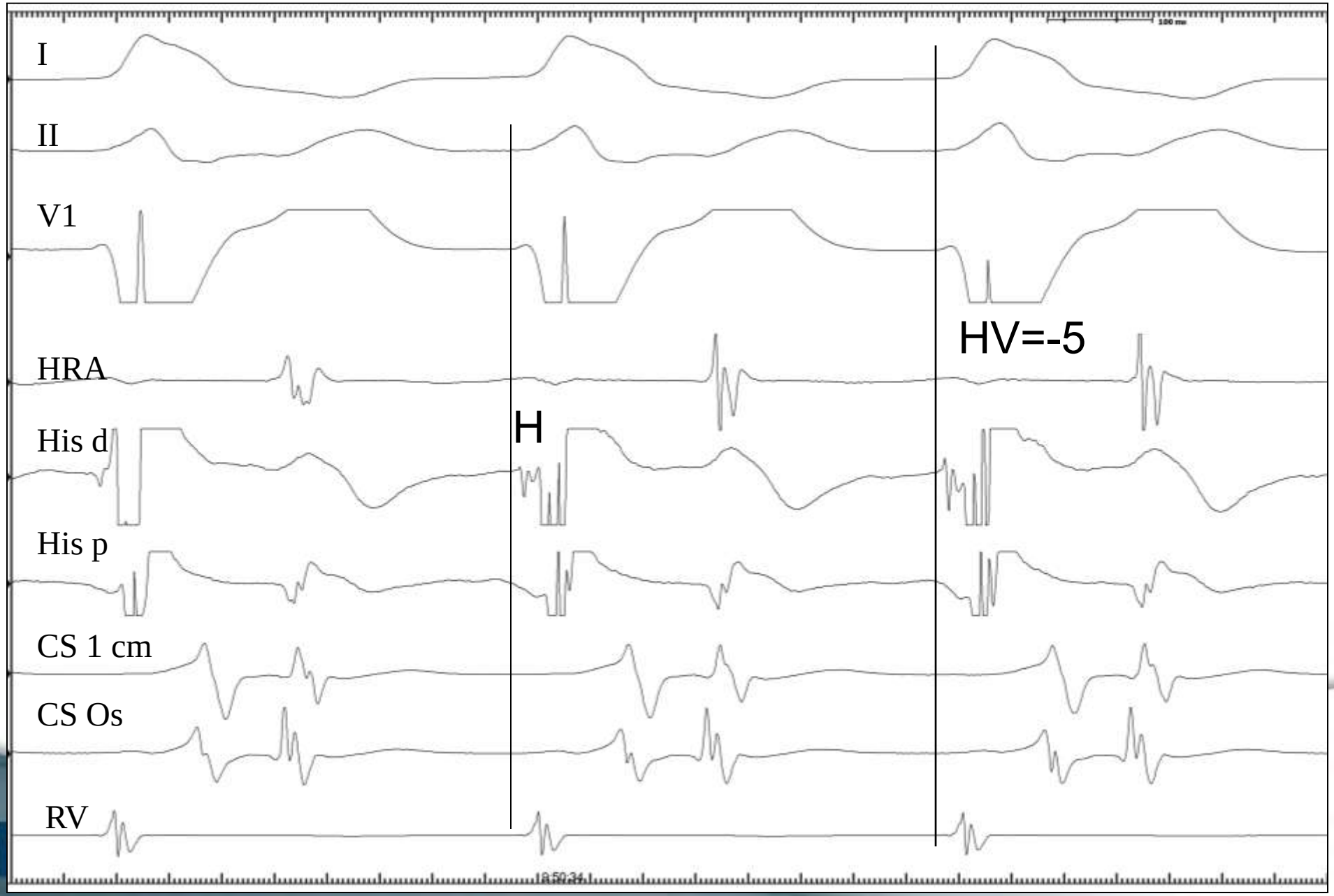
Atrial extrastimulus during SR, CI 310 ms



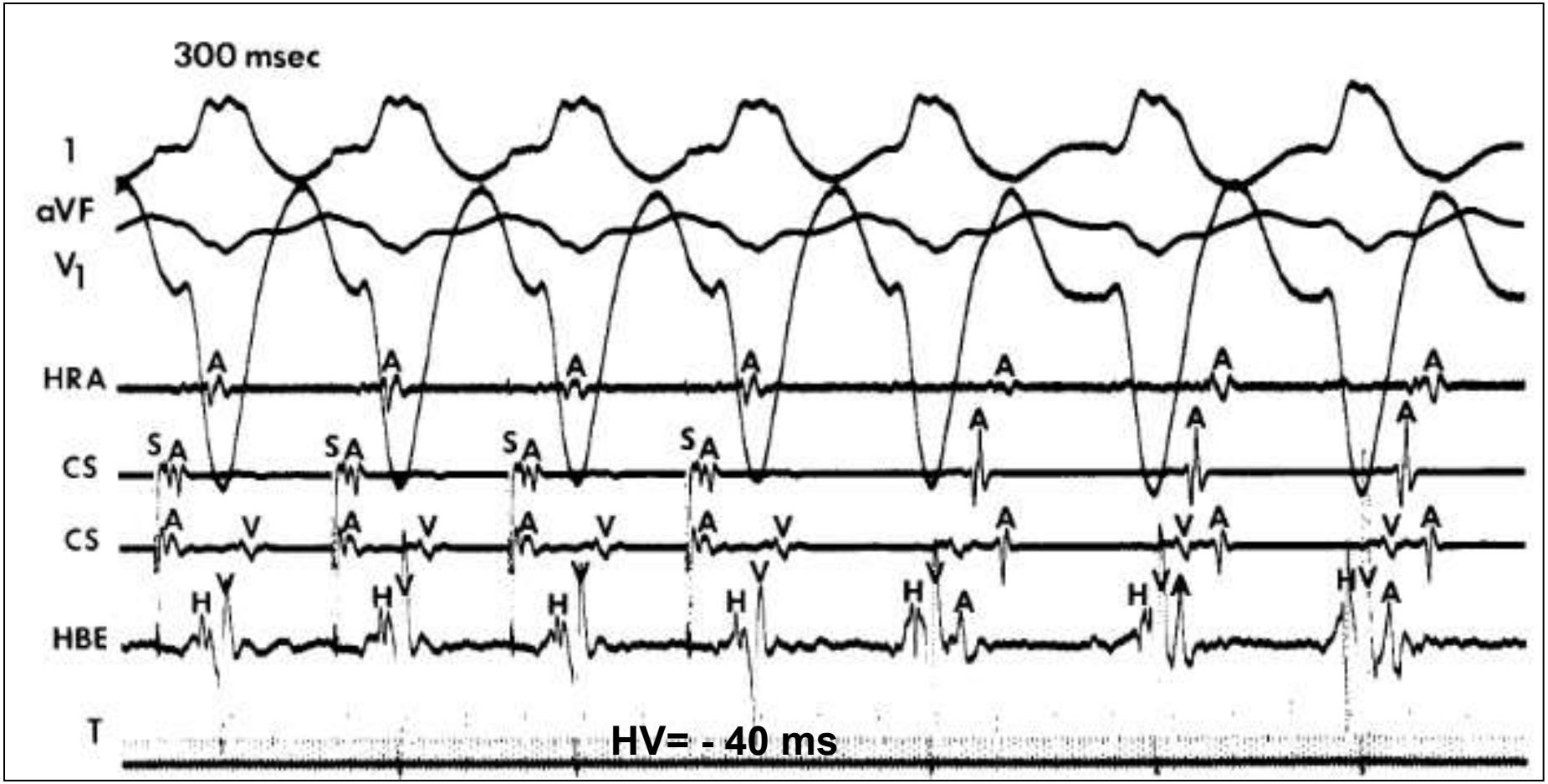
Atrial extrastimulus during SR, CI 270 ms



Defining ventricular insertion: HV interval during tachycardia

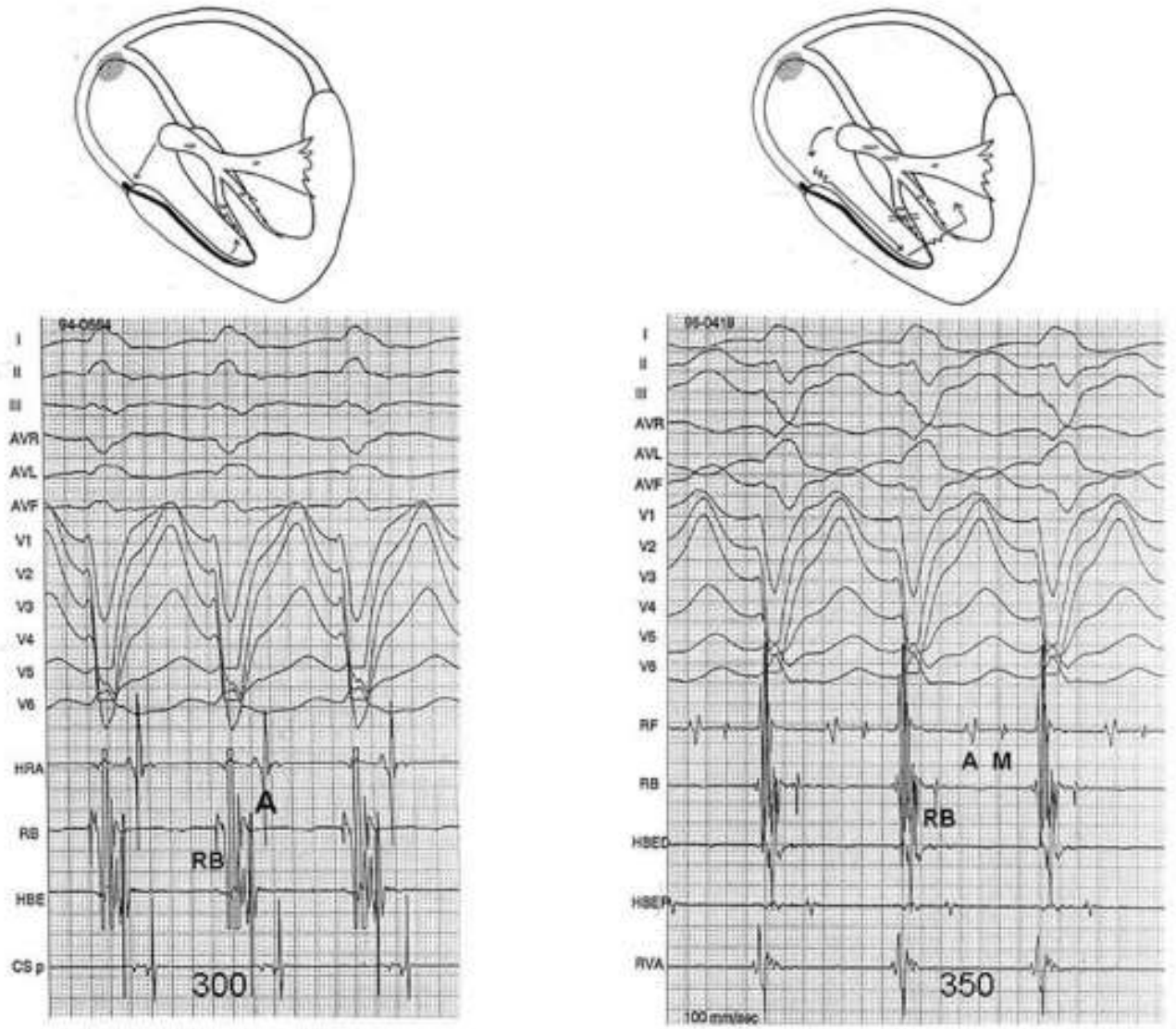


Intermediate HV interval during fully preexcited QRS



Josephson ME: Clinical Cardiac Electrophysiology. 2008 Lippincott Williams & Wilkins

Influence of retrograde RBBB



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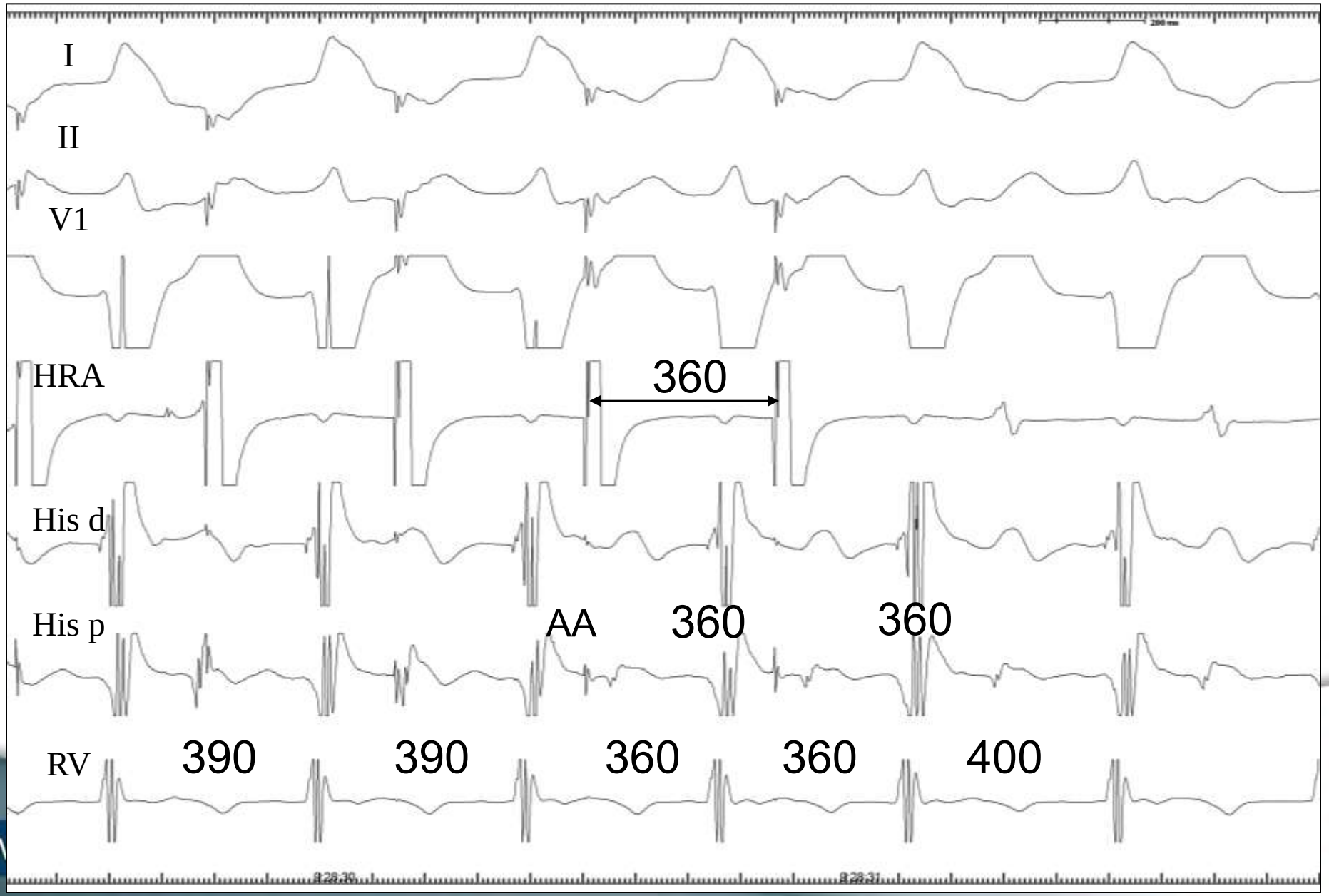
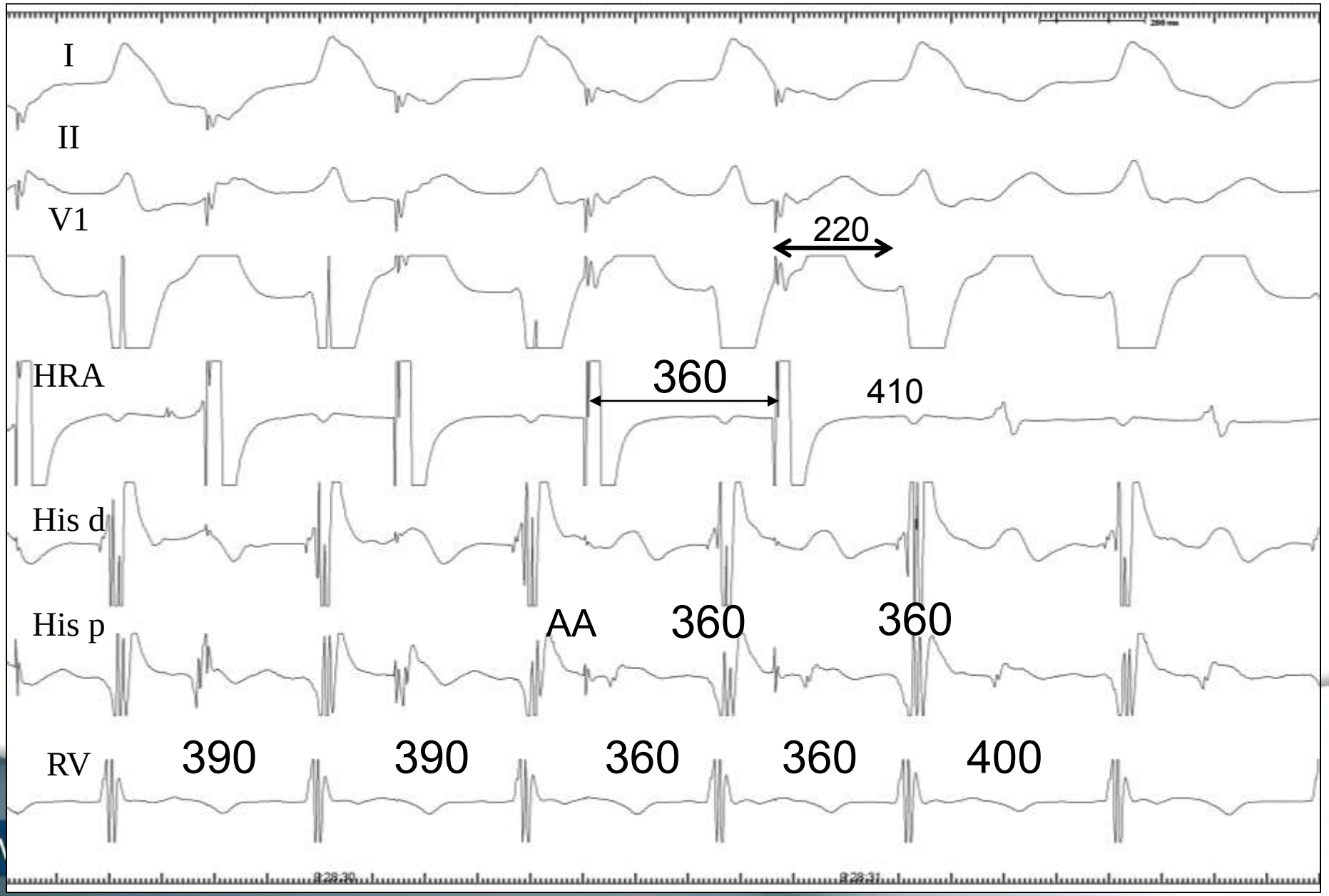
Defining atrial insertion: atrial stimulation during tachycardia

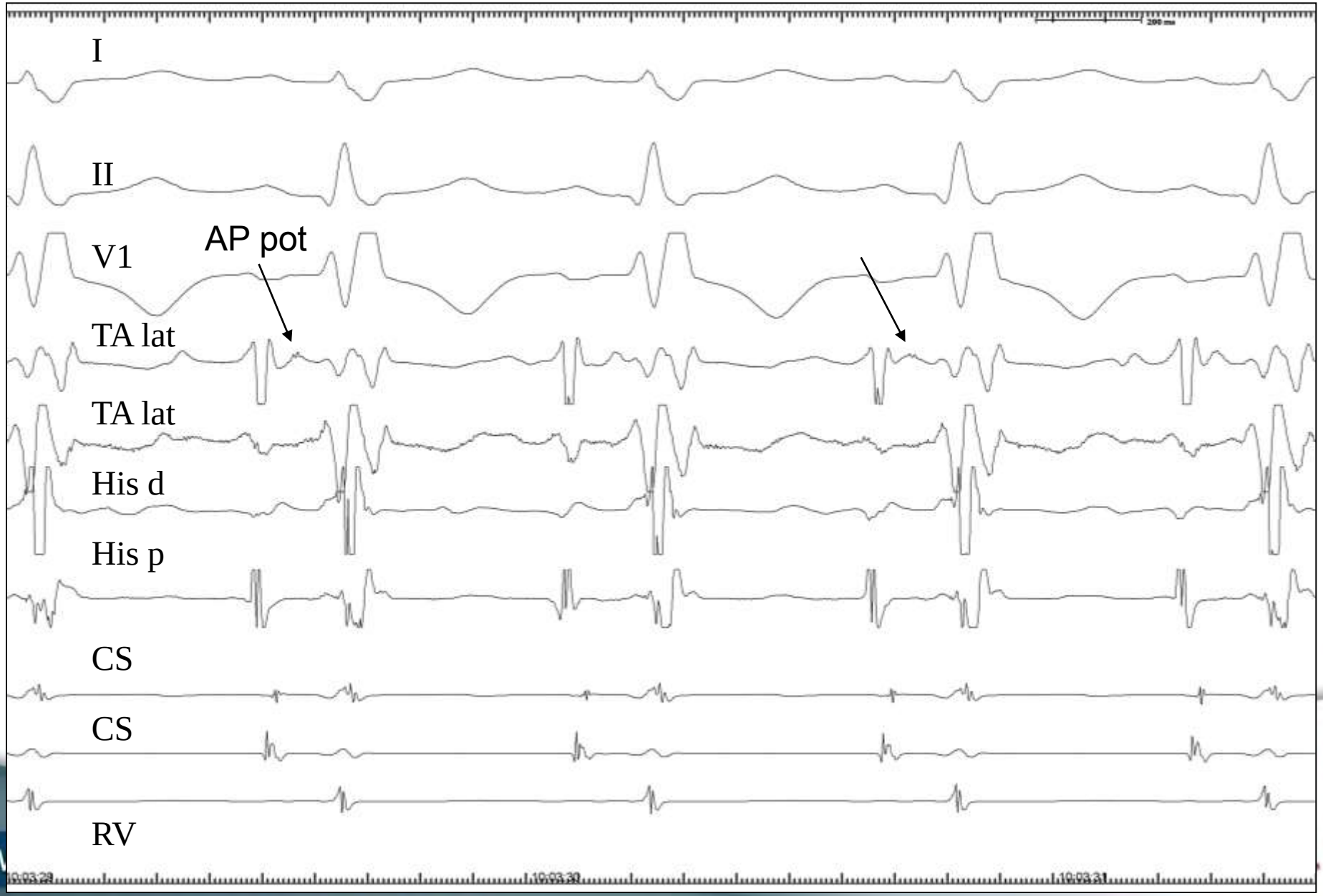


Lateral atrial stimulation during tachycardia, PCL 360 ms

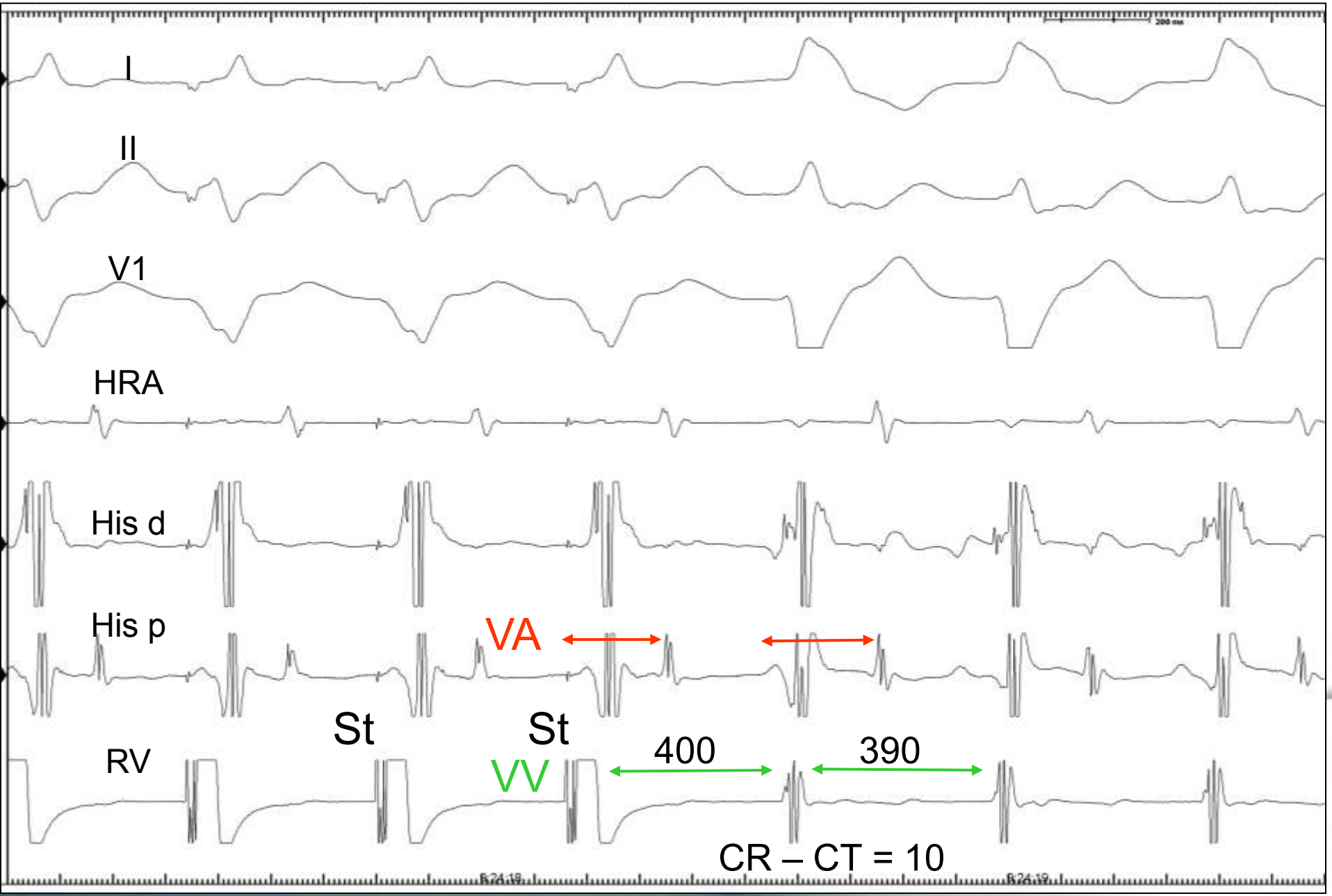


Septal atrial stimulation during tachycardia, PCL 360 ms

Atrial insertion: look for AP potential at lateral tricuspid annulus



Defining tachycardia circuit: ventricular stimulation



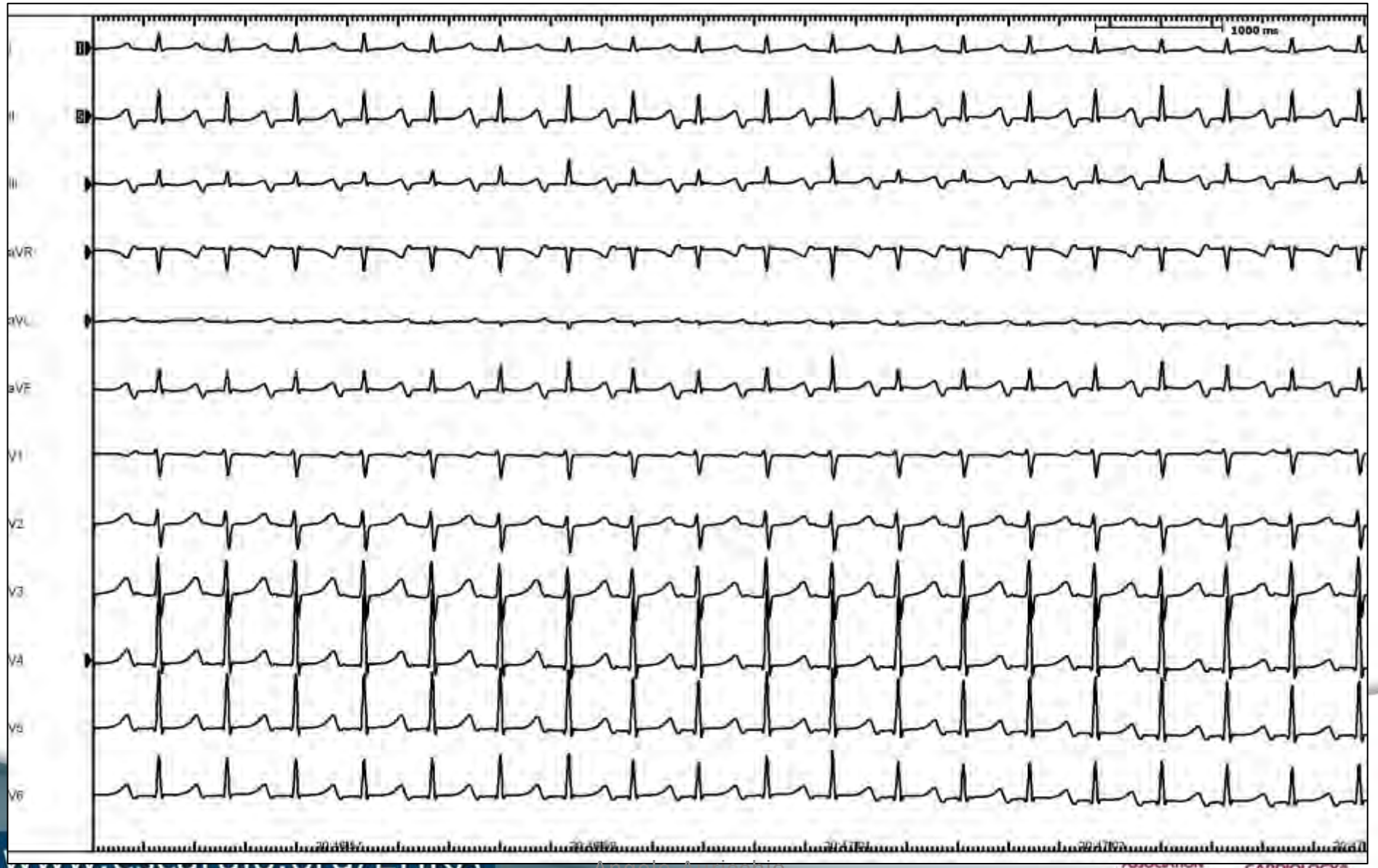
Concealed AP with long conduction time: common features

- Location: posteroseptal
- Proximal insertion: A, Distal insertion: V
- Conduction time: long, usually decremental
- No antegrade conduction

Consequences:

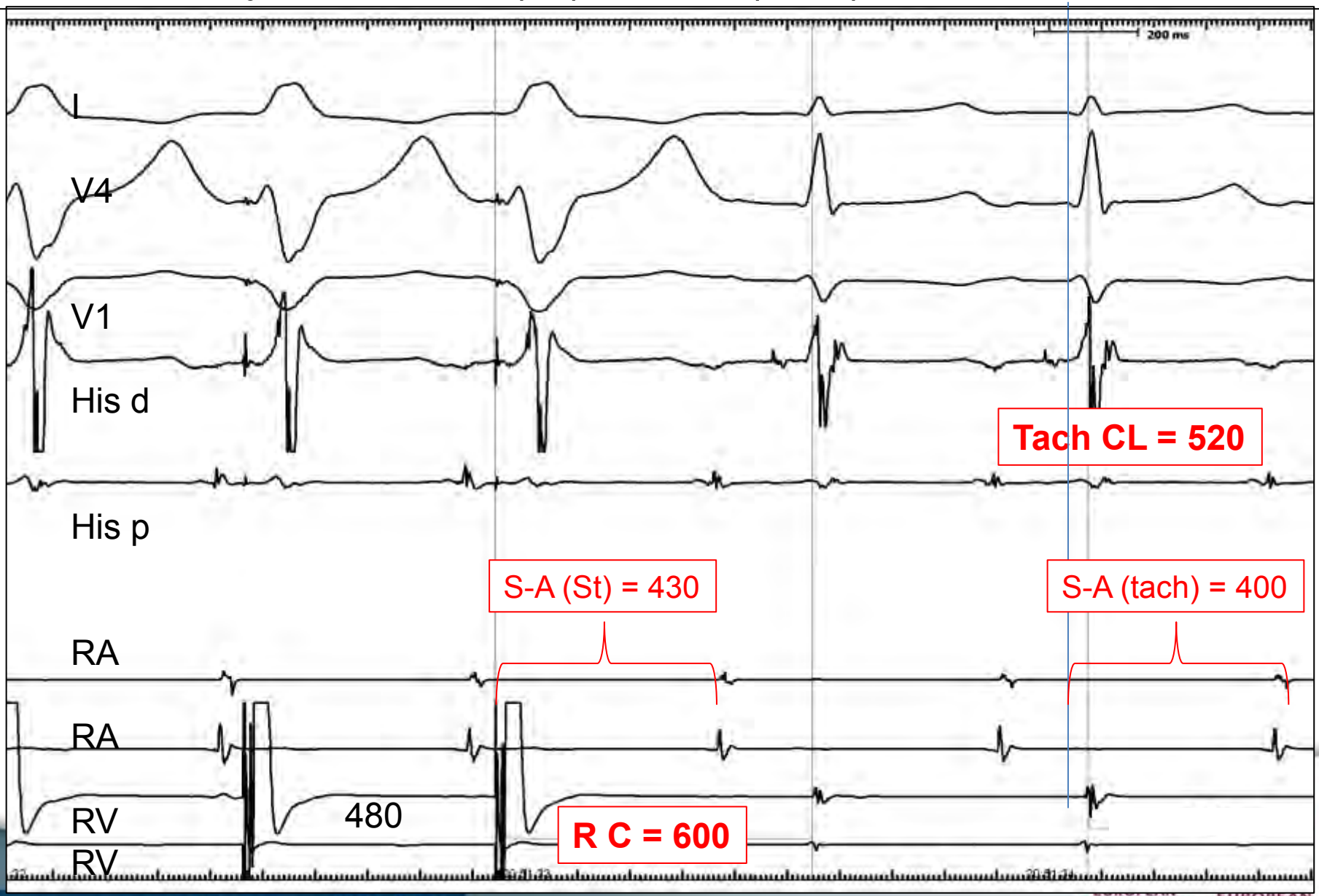
- Normal ECG in SR
- Long RP narrow QRS tachycardia
- Tachycardia frequently incessant, easy to induce
- Demonstration of AP, theoretically easy by V extrastimuli w His refrac, limited by tachycardia irregularities and termination with stimulation

12-lead ECG during tachycardia



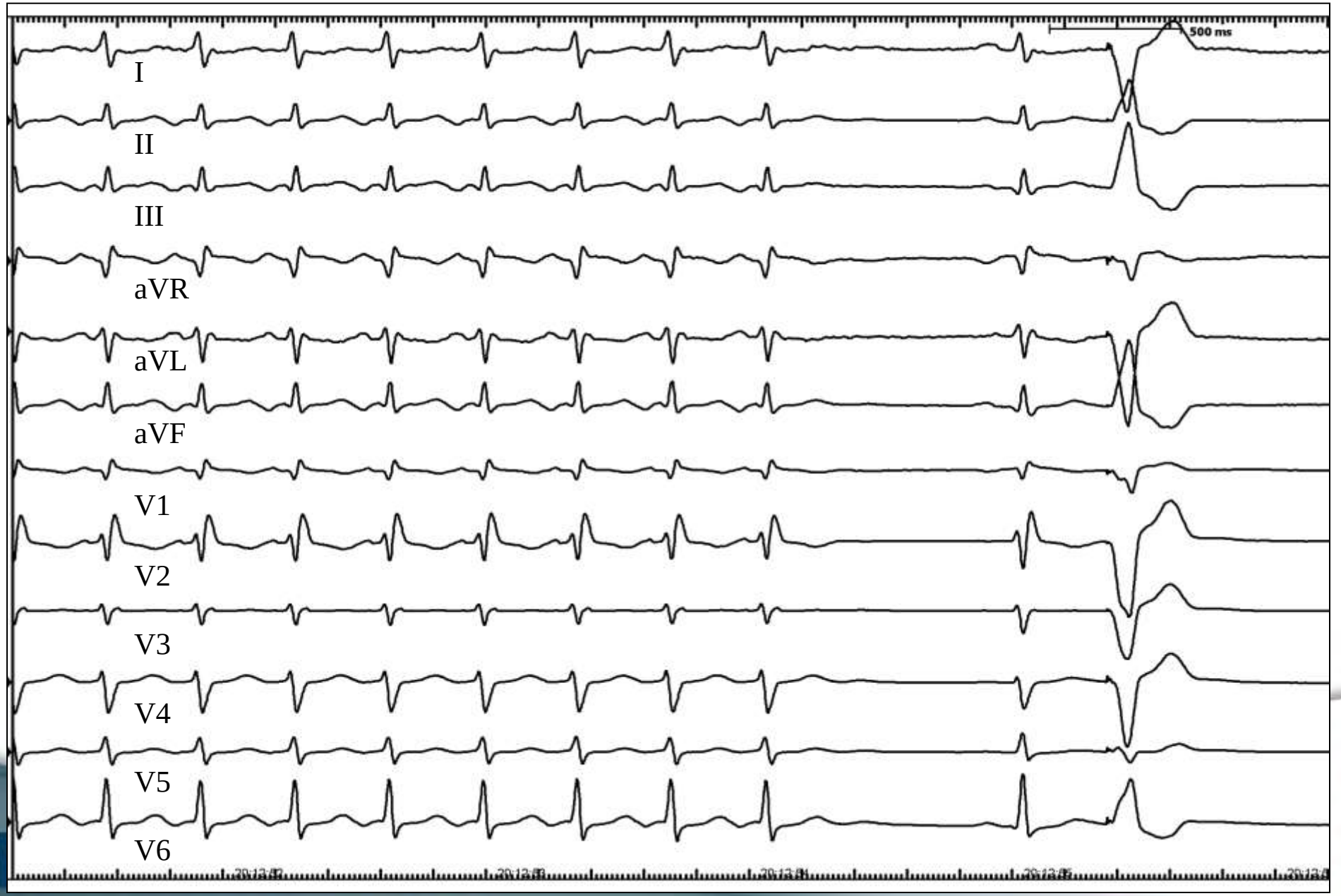
Defining presence of AP: V extrastimuli advances A w His refrac

Return cycle and S-A(St) vs S-A (tach) consistent with AP

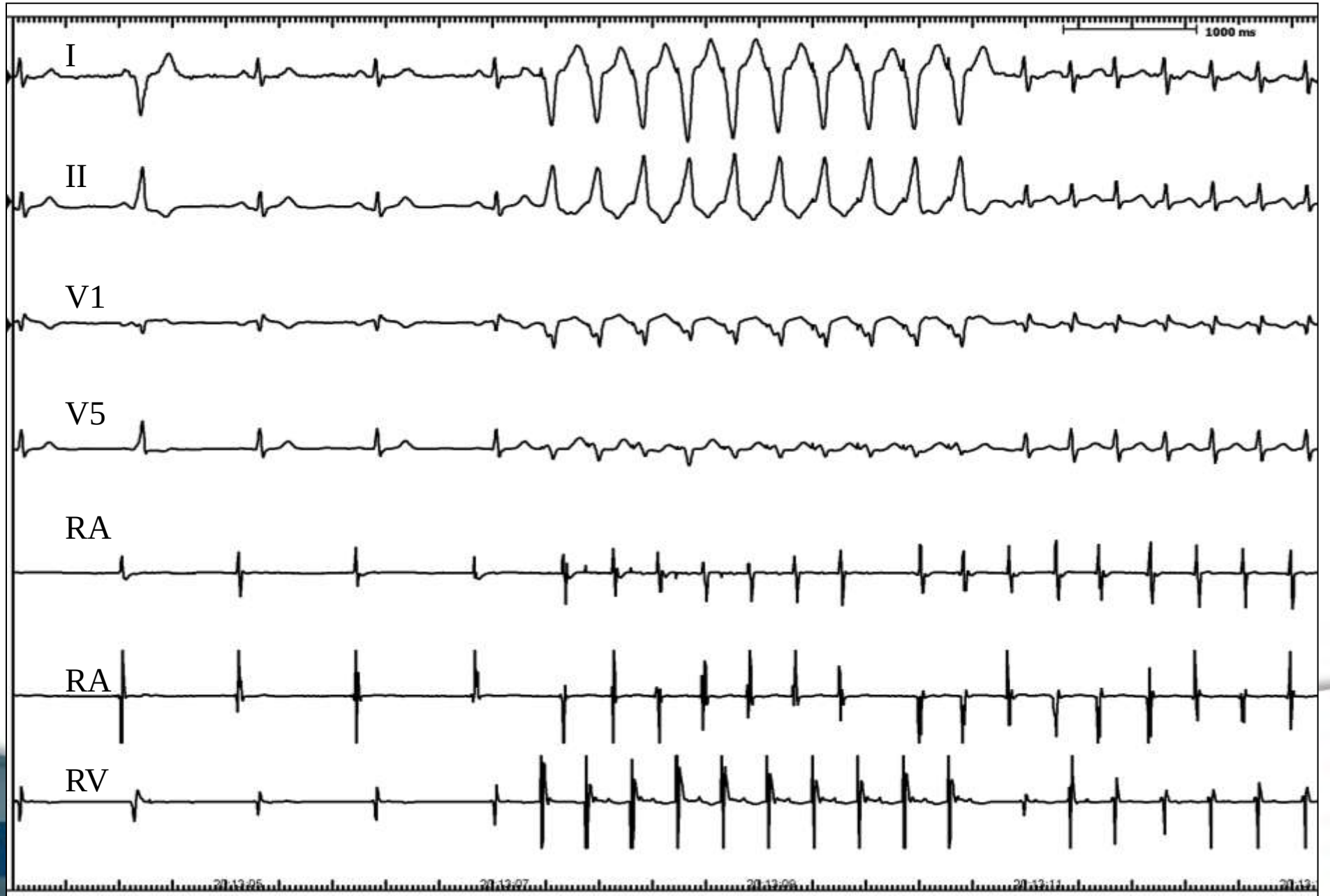


Fibers are frequently narrow …

12-lead ECG

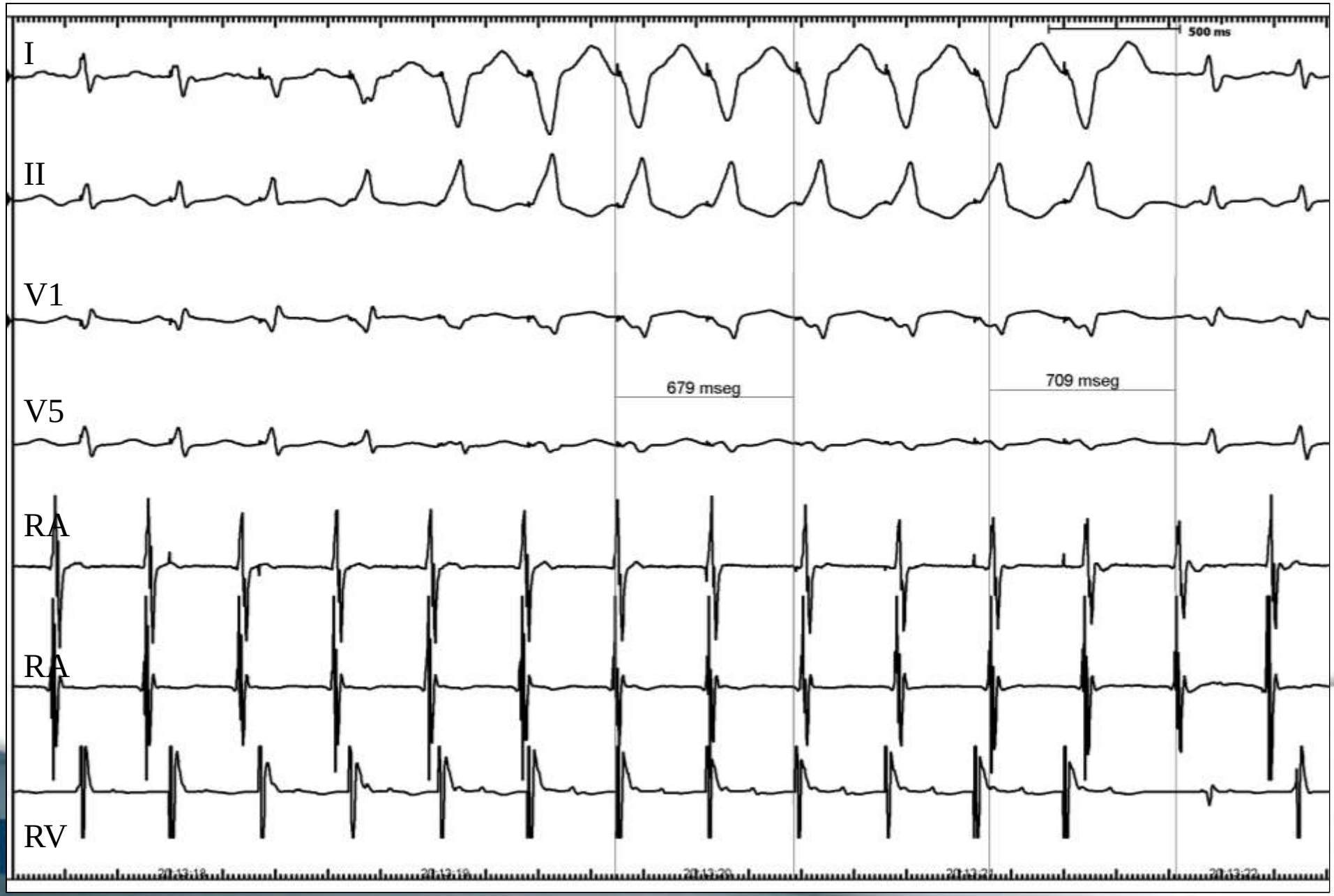


Ventricular pacing train during SR initiated tachycardia (50 mm/sec)

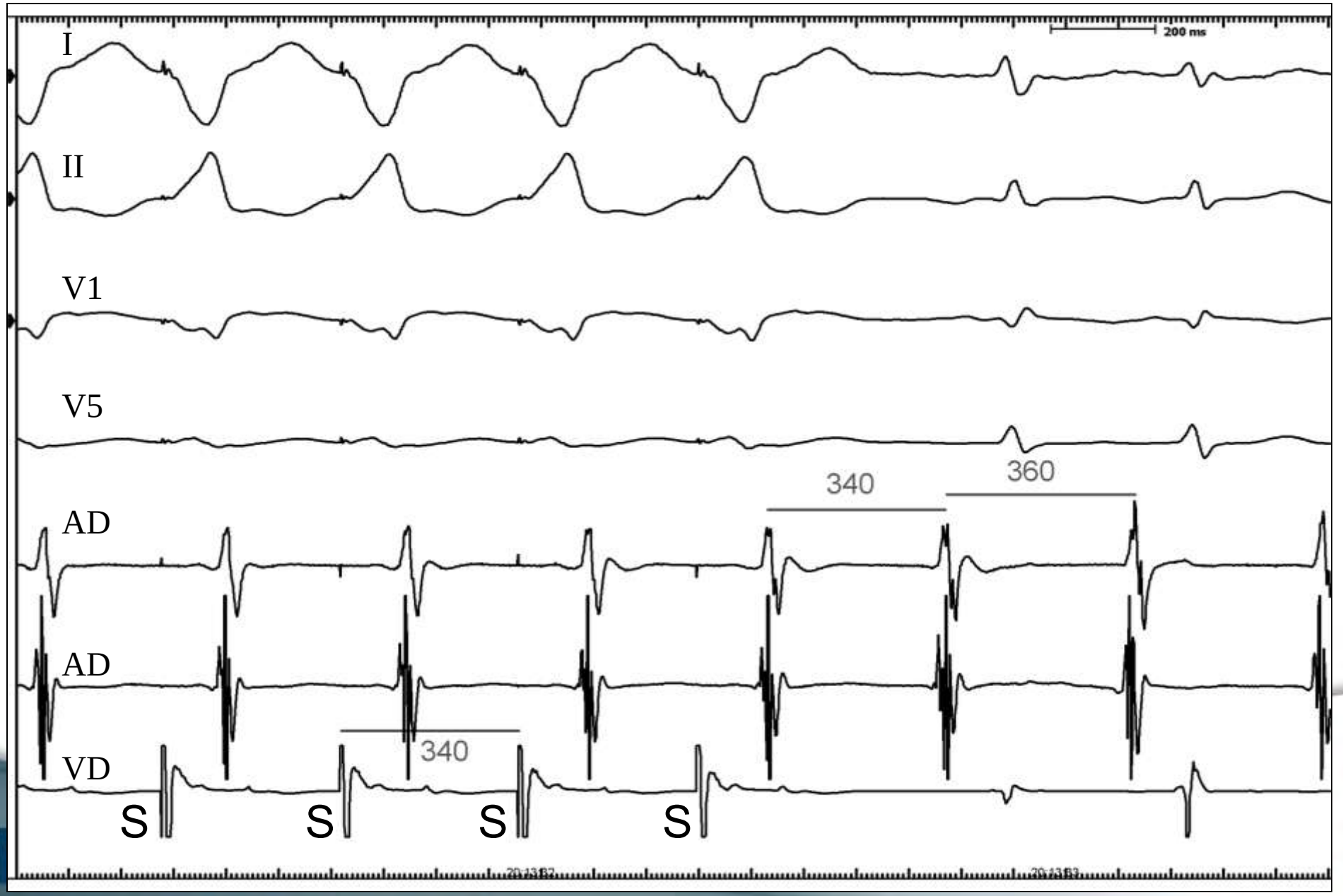


Ventricular pacing train during SR initiated tachycardia (100 mm/sec)

11-beat ventricular pacing train (CL 340) during tachycardia (CL 355 ms)



>30-beat ventricular pacing train (CL 340) during tachycardia (CL 355 ms)



What is the most likely mechanism of this tachycardia?

1) Atrial tachycardia
2) Orthodromic tachycardia (long conducting time accessory pathway)
3) AVNRT (slow-slow)
4) Uncommon AVNRT
5) Common AVNRT

A ventricular pacing train during SR initiates tachycardia. During the pacing train there are 2 QRS without atrial electrogram in between. What is the most likely mechanism of this phenomenon?

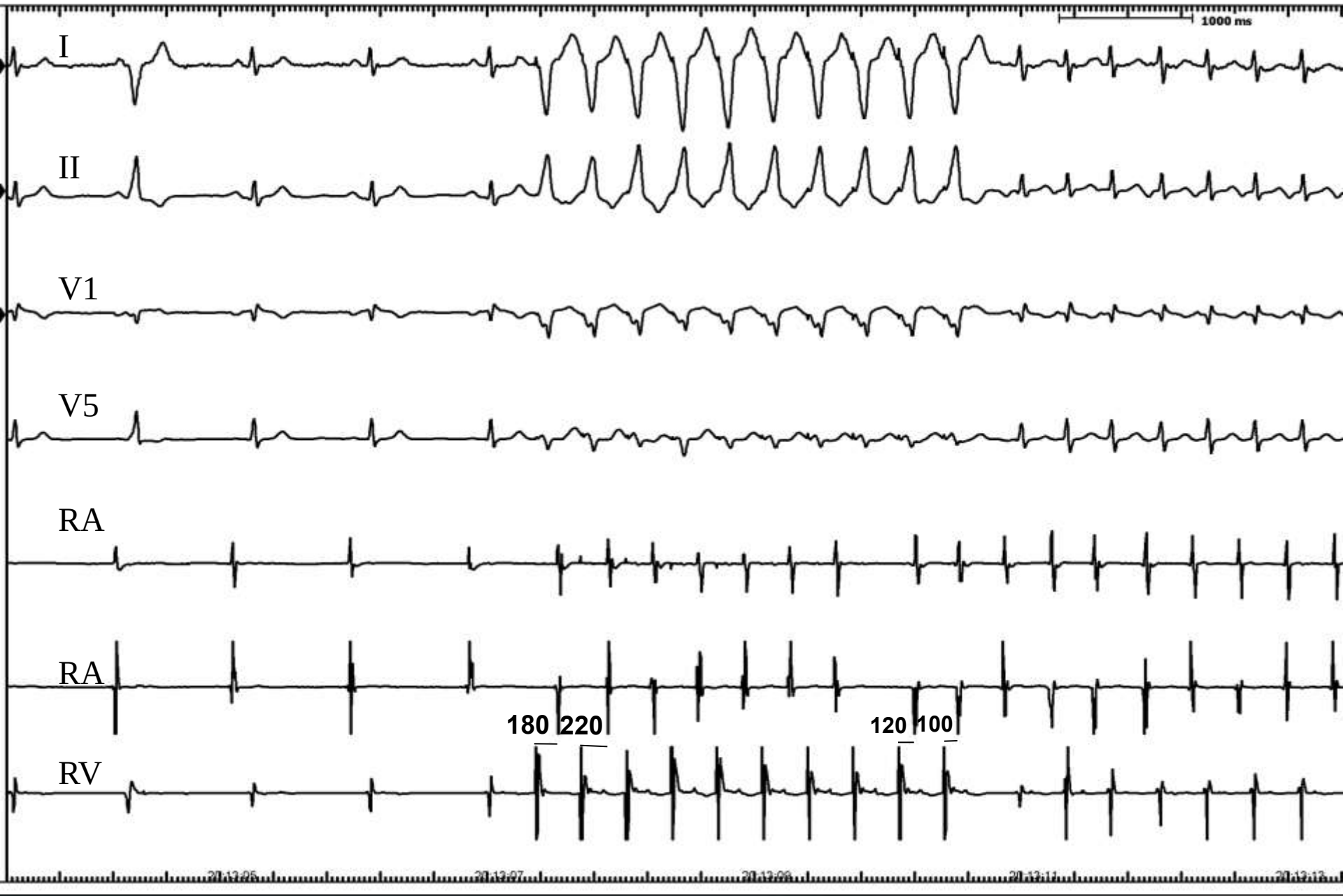
1) Retrograde dual AV nodal pathways
2) Retrograde Wenckebach
3) First few beats conducted through an AP and last beats conducted through specific conduction system
4) First few beats conducted through specific conduction system and last beats conducted through an AP
5) Catheter displacement

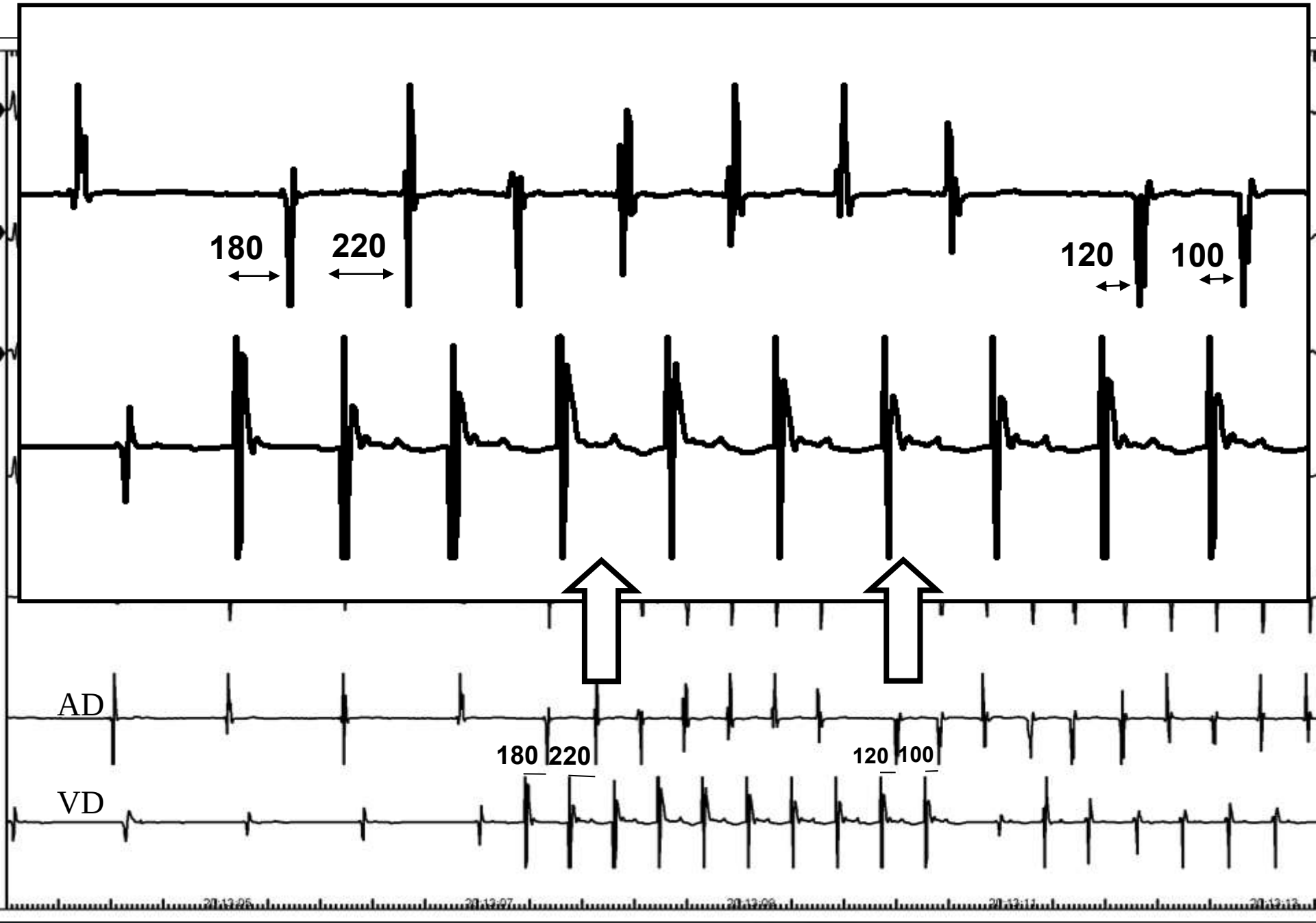
The observed response to a ventricular pacing train at a constant rate during tachycardia:

1) Has been described as typical of AVNRT
2) Has been described as typical of atrial tachycardia
3) Has been described as typical of orthodromic tachycardia (AP mediated)
4) Has been described as typical of ventricular tachycardia
4) Has not been described as typical of any arrhythmia

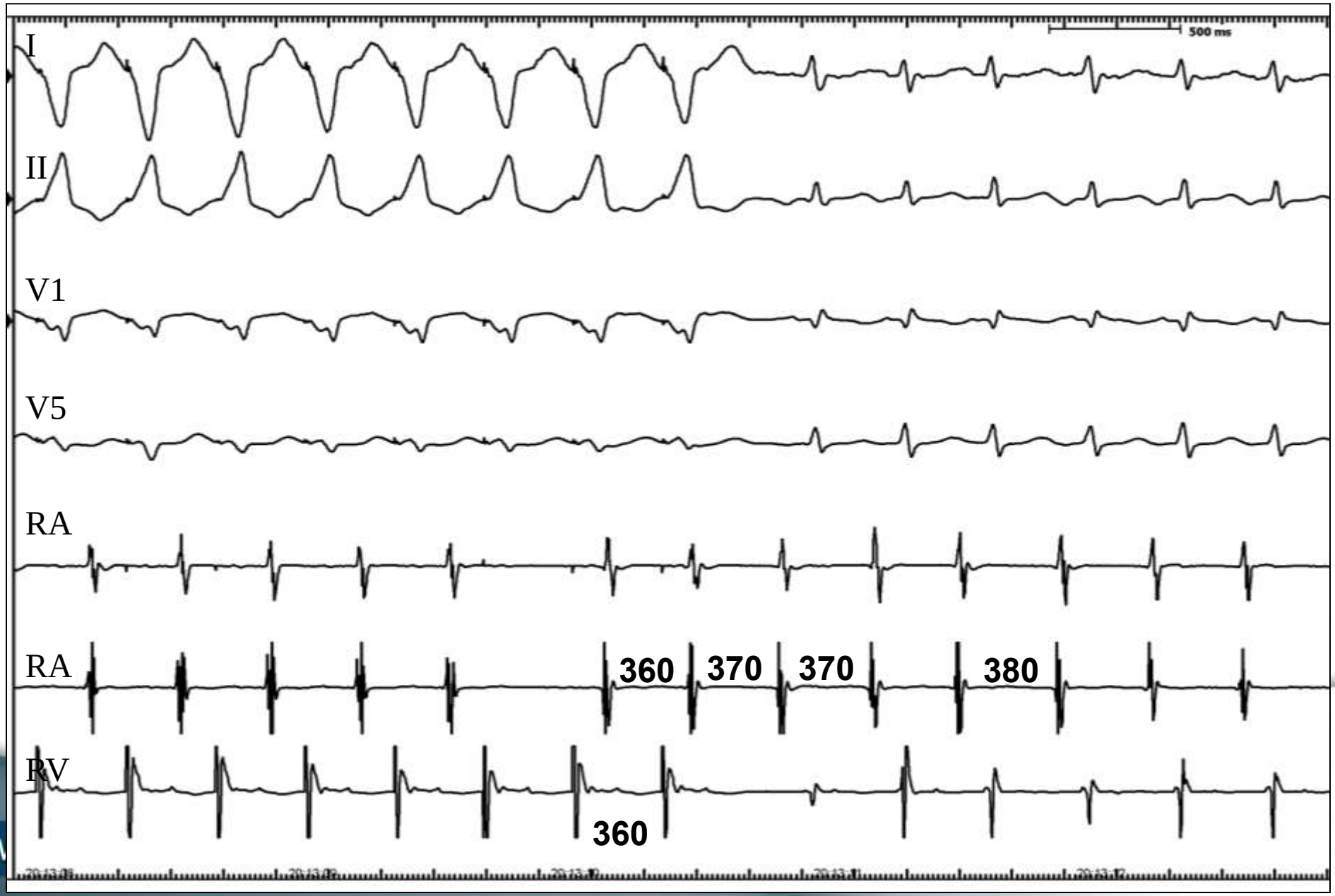
MEASUREMENTS
AND
ANSWERS

2 QRS without A in between: VA Wenckebach?




180
220
120
100
AD
180 220
120 100
VD

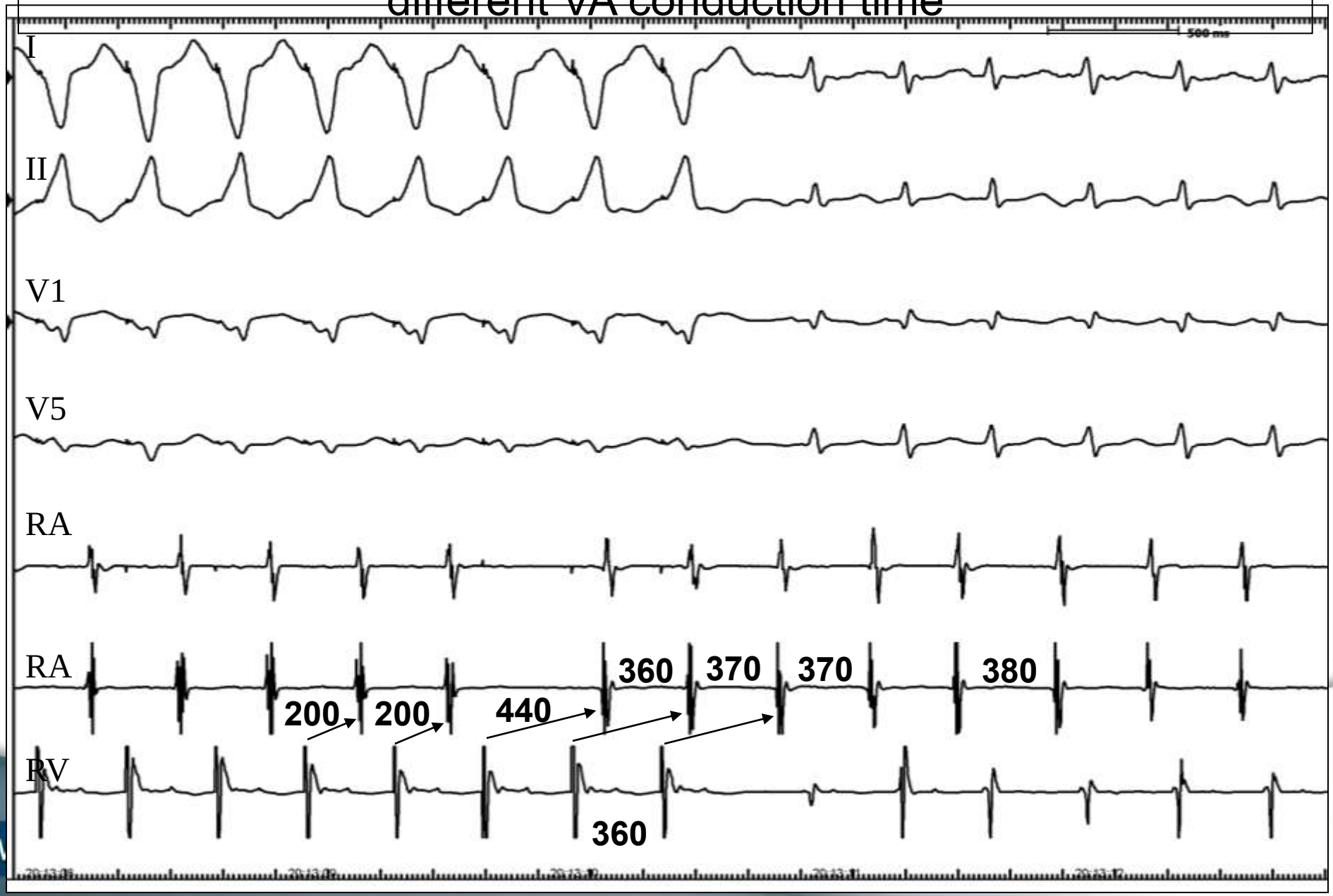
Measuring AA intervals



In summary, behavior during ventricular stimulation unlikely for VA Wenckebach:

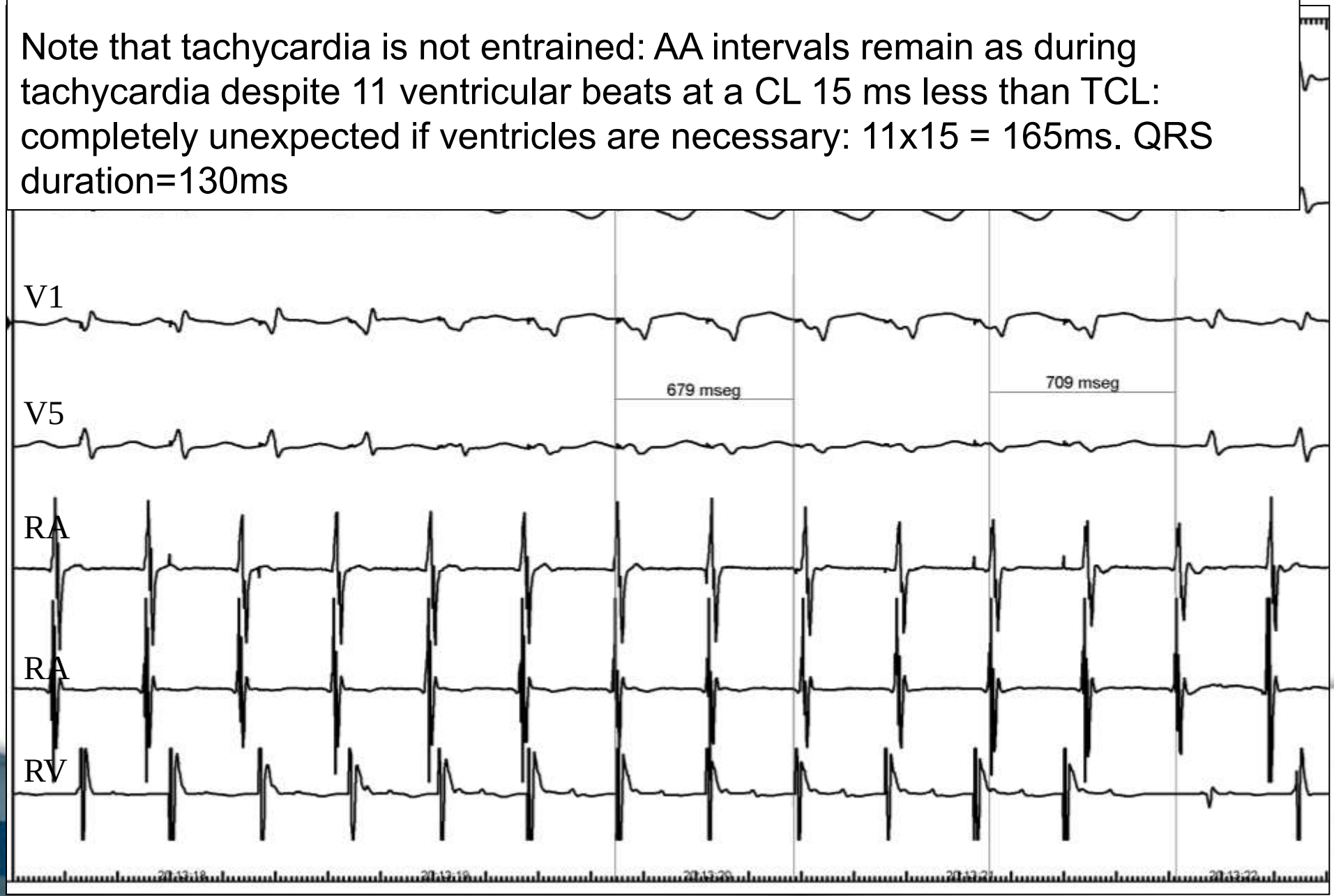
1) VA unexpectedly short after block as compared to at initiation of pacing
2) VA after block decreases not increases
3) AA relativelyconstant after VA block
4) Hard to explain 2nd A after last paced beat

Alternative explanation: 2 pathways for VA conduction with different VA conduction time



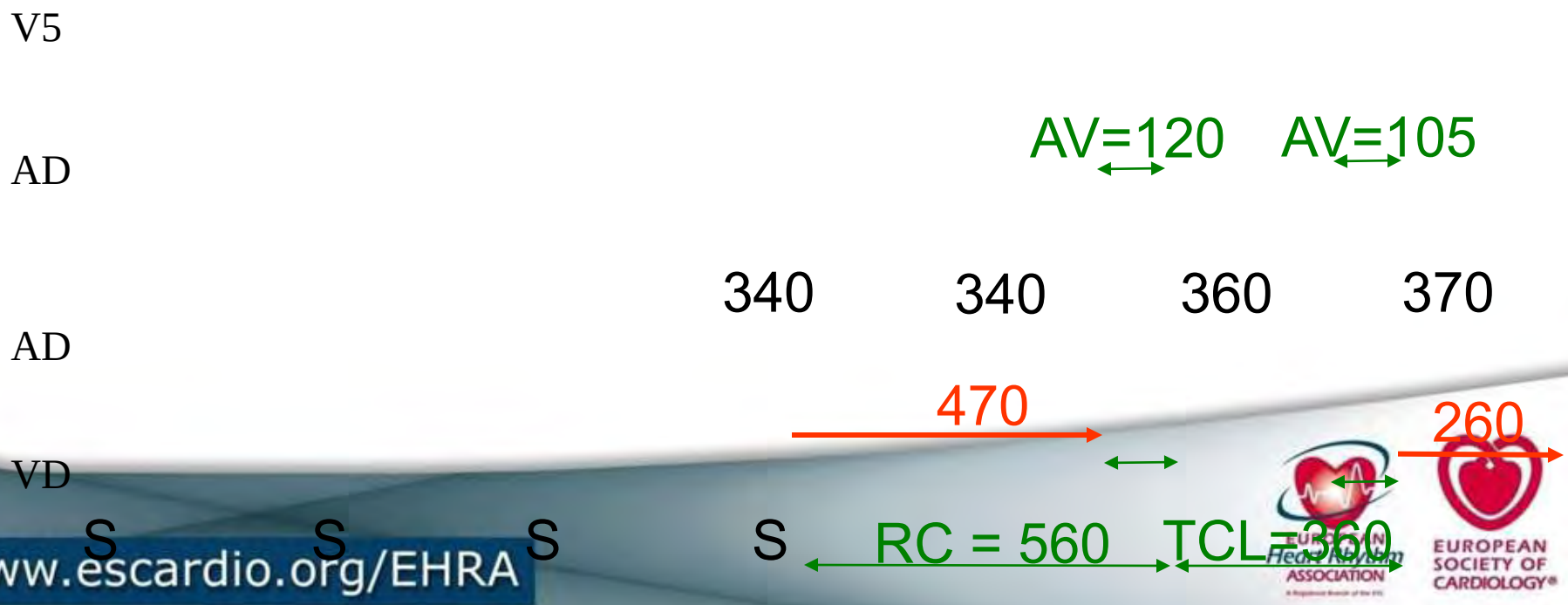
11-beat ventricular pacing train (CL 340) during tachycardia (CL 355 ms)

Note that tachycardia is not entrained: AA intervals remain as during tachycardia despite 11 ventricular beats at a CL 15 ms less than TCL: completely unexpected if ventricles are necessary: 11x15 = 165ms. QRS duration=130ms



>30-beat ventr. pacing train (CL 340) during tachycardia (TCL 365 ms): Tachycardia is entrained. Please note:

1) There is a VAAV response that has been described as typical for AT
2) Last entrained A is the 2nd after last paced V, and paced VA=470
3) This is a false VAAV response, for it to be true 1st A after last paced V should be the last entrained A
4) Return cycle (RC)=560 ms – TCL (360) = 200ms, correction for diff in AH (or AV) is only 15 ms, so corrected RC-TCL=185ms ⇒ AVNRT
5) Marked difference in paced VA (470) vs tach VA (260) favors AVNRT



As a summary of the findings:

1) The most likely mechanism is atypical AVNRT
   a. Response to pacing during tachycardia is inconsistent with an AP mediated SVT
   b. Apparent VAAV response should be re-interpreted
   c. SVT initiation suggests dual VA conduction
2) The response to V pacing for SVT initiation is not Wenckebach but jump from fast to slow retrograde AVN pathway or a 1 to 2 response
3) The observed response to V-pacing during SVT, although described for AT needs reinterpretation

The uncommon form of AV nodal reentry: common features

- Location: AV node, slow pathway at CS os
- Function: up the slow, down the fast
- Retrograde conduction time: long, always decremental

Consequences:

- Normal ECG in SR
- Long RP narrow QRS tachycardia
- Tachycardia frequently incessant, easy to induce
- AP cannot be demonstrated
- V extrastimuli modify the timing of A advancing the His
- S-A (stim) exceeds V-A (tach) by more than 110 ms

Parahisian pacing during tachycardia: change in VA depending upon QRS duration